SUPER-POWER KLYSTRON TUBE-TEST FACILITY

G-108

Quarterly Report No. 9

for the period

October 1, 1962 through December 31, 1962

Prepared for

Varian Associates
611 Hansen Way
Palo Alto, California

RADIATION at Stanford

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Written by: R. L. Blessing
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1 March 1963

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During this quarter equipment installation and interconnection was completed with the exception of the crowbar. The interim modulator tests were completed and the modulator was delivered to the site and interconnected with the remainder of the system. All system interconnection wiring and piping were completed and tested. The beam supply tests were completed into a d-c dummy load and this portion of the system performed satisfactorily.

The bias supply, resistors, bushings and covers associated with the klystron/modulator tank were installed and tested where appropriate. The crowbar fabrication has been completed and preliminary tests are now being conducted before delivering it to the site.

I. BEAM SUPPLY

During this period the beam supply high voltage tests were completed with the exception of those tests that will be performed in conjunction with the crowbar. The power supply was subjected to a heat run and performed satisfactorily with some minor exceptions to be discussed.

During the course of the initial beam supply tests, the oil circuit breaker was damaged. This breaker was not filled with oil at that time. Consequently, the fact that a malfunction occurred can only be attributed to the absence of oil in the breaker. Normal procedure in the case of oil breakers is to appropriately tag the unit so as to indicate that it has not been filled with oil and this tag is

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During the course of the initial beam supply tests, the oil circuit breaker was damaged. This breaker was not filled with oil at that time. Consequently, the fact that a malfunction occurred can only be attributed to the absence of oil in the breaker. Normal procedure in the case of oil breakers is to appropriately tag the unit so as to indicate that it has not been filled with oil and this tag is

then removed at the time the breaker is filled. This particular breaker was in storage for a significant period of time at RADIATION at Stanford before being installed in the input power control unit. The input power control unit was also stored for a significant period of time before it was installed at the site and prepared to be placed in operation. At some point during this time span, the tag was removed and thus indicated that the breaker had been filled with oil. Additional safeguards have been added to this procedure in order to prevent future reoccurrences of this type. A replacement assembly was obtained and installed in the input power control unit, along with the undamaged breaker operating mechanism. At this time the high voltage tests were resumed and additional difficulties have not been encountered with this unit.

While performing the high voltage tests, the Inductrol, plate transformer, protective circuitry and rectifiers were closely observed for indications of malfunction. The Inductrol exhibited considerable noise and vibration which was sufficient to cause movement of the tank sides. This vibration was also sufficient to cause an Inductrol control relay malfunction. These difficulties were investigated by General Electric field personnel on a number of occasions and included a measurement of the vibration magnitude as a function of position on the tank walls. The control relay problem was solved at the site by the General Electric field representative. However, it was necessary to refer the vibration problem to the design engineers for their consideration. After the Inductrol design and test data was reviewed, RADIATION at Stanford was

advised by General Electric that the vibration and noise would not affect the operation of the unit and was not considered excessive. General Electric will provide written confirmation of this information as well as provide a statement to extend the warranty on this unit for one year after the unit was energized. During the power supply heat run the temperature rise on the Inductrol was noted and reported to General Electric for their information. This Inductrol was designed with a 55°C temperature rise, and this temperature rise corresponds to that observed during the heat run tests. Therefore, although there is significant vibration in this unit there are apparently no temperature problems resulting from this vibration.

During the beam supply heat run the temperature of the vacuum switches and their associated busses was noted. The operating temperature of these units is higher than RADIATION at Stanford personnel would prefer to operate this equipment, although these switches have been discussed with and are operating within the manufacturer's recommended current and temperature ranges. A decision has been made to add a cabinet fan and associated filters to the input power control unit in order to reduce the operating temperatures of the busses and vacuum switches.

II. FINAL MODULATOR (Ground Deck, Buffer Deck and Floating Deck)

The final modulator stop work order continues in effect at this time. Consequently, additional modulator effort was not expended during this quarter. RADIATION at Stanford has been requested to supply additional technical and

cost information on this modulator, and this information will be submitted early in the next quarter. The final modulator program will be continued at the time authorization is received.

III. MAGNET SUPPLIES

The magnet supplies have been permanently installed at the site and are available for use by Varian during the klystron magnet structure test program.

IV. KLYSTRON FILAMENT TRANSFORMER

At the beginning of this quarter this transformer had been installed in the pit at the site and connected to the klystron tank. Tests on this transformer remain to be performed in conjunction with the modulator, bias supply, beam supply and klystron. All tests, with the exception of those associated with the klystron, will be completed early in the next quarter.

V. MOD-ANODE BIAS SUPPLY AND ASSOCIATED COUPLING RESISTORS

During this quarter these components were installed in the modulator section of the klystron/modulator tank. The mod-anode bias supply was subjected to preliminary tests before installation in the tank, but it will also be operated using the klystron filament transformer early in the first period of the next quarter. These components will be high voltage tested along with the high voltage transmission line, and pulse tested by means of the interim modulator early in the next quarter.

VI. COOLING SYSTEM

At the beginning of this quarter the cooling system components had been installed at the site, but it was necessary to install the piping from the cooling system area to the water manifolds and to the interim modulator in order to complete this portion of the system. This piping was completed early in this quarter and the system was pressure tested prior to turn-on. The system was operated and water was circulated by means of a bypass at the manifold. Temporary connections were then made to the cooling system in order to cool the d-c dummy load during the beam supply full load tests. This system was operated continuously during these tests and performed satisfactorily. The temporary connection to the d-c load will be removed early in the next quarter and the cooling system returned to its normal configuration. The system will be operated during the remainder of the interim modulator tests. Water connections will be made from the water manifold to the magnets and klystron by Varian personnel at the time the magnets and klystron are installed in the klystron tank.

VII. D-C DUMMY LOAD

The required dummy loads to perform the beam supply high voltage tests were provided by RADIATION at Stanford. These loads were installed in the high voltage vault in the space to be occupied by the crowbar. These loads were connected to the main cooling system in order to obtain adequate cooling for the tests. With these tests now complete, these loads will be

removed from the vault in order to allow the crowbar to be installed early in the next quarter.

VIII. CONTROL CONSOLE

At the beginning of this quarter this console had been delivered to the site and was to be installed on a schedule compatible with the installation of the interim modulator. This installation was completed during this quarter and the major portion of the interconnecting wiring to this console was tested. The beam supply control panels were removed from the console and operated remotely during the beam supply tests. With these tests now complete, the panels will again be installed in the control console and the necessary check-out and testing performed.

IX. COLLECTOR/BODY CAPACITOR BANKS

At the beginning of this quarter these banks had been installed in the high voltage vault and were available for the high voltage test phase. During this quarter a portion of the capacitors in the collector/body capacitor banks developed minor oil leaks in the capacitor cases. Two of these units were returned to Cornell-Dubilier for immediate evaluation in order to determine the necessary repair procedure. It was determined that repairs could be effected immediately without requiring the capacitors to be rebuilt. The remaining 41 defective units were removed from the banks and delivered to the manufacturer for repairs. These units were returned to RADIATION at Stanford during the

quarter and were again installed in the capacitor banks. Approximately 25 additional capacitors developed minor leaks, and it was also necessary to return them to the manufacturer for repair. These units are scheduled to be returned to RADIATION at Stanford early in the first period of the next quarter. These additional defective units represent a small portion of the total capacitor units contained in the body/collector banks. Consequently, it was not necessary to delay the high voltage tests.

These capacitor banks were subjected to full power supply voltage during the power supply high voltage tests. The tests were completed without evidence of malfunction or component failures. These capacitor banks will be subjected to crowbar service early in the next quarter during the crowbar tests at the site.

X. CROWBAR

During this quarter the crowbar fabrication phase was completed and the unit entered the test phase. A number of component delivery problems were encountered during the quarter including high voltage resistors, high voltage capacitors, the lucite enclosures and the ball gaps. The structures utilized to support and connect these components were completed prior to the component delivery, and upon receipt the resistors and capacitors were installed in their respective locations completing this portion of the crowbar system.

Crowbar tests were initiated at RADIATION at Stanford during the last period of this quarter. These tests include both normal equipment checkout

as well as adjusting the ball gap spacing and triggering electrode placement in order to obtain reliable triggering while obtaining holdoff voltage capability compatible with operation in the final system. The final crowbar tests will be conducted after the crowbar is installed at the site. These tests will include triggering the crowbar, using power supply fault signals as well as discharging the beam supply capacitor banks through the crowbar device. Tests will also be conducted to measure the crowbar performance and effectiveness in the system enviornment as well as testing its interaction with the remaining system components.

The preliminary tests now in process at RADIATION at Stanford are now scheduled to be completed during the first week of the next quarter. The crowbar will then be transported to the site, installed, and final tests initiated.

XI. CROWBAR LOGIC CIRCUITS

The final fabrication of these circuits was completed during the quarter and portions of the circuitry were operated in conjunction with the crowbar tests at RADIATION at Stanford. The preliminary tests were completed at RADIATION at Stanford during this quarter. However, it is necessary to perform the final evaluation tests in the system environment. Consequently, these final tests will be performed at the site along with the final crowbar tests.

XII. INTERIM MODULATOR

At the beginning of this quarter all interim modulator equipment had been completed and tested at RADIATION at Stanford. During the course of

the final pulse transformer tests a transformer failure occurred, and it was necessary to rebuild the pulse transformers. This effort was completed early in this quarter, and transformer tests were again initiated.

Revised test specifications for these transformers were discussed and mutually agreed upon by RADIATION at Stanford, Varian Associates and Signal Corps personnel. It was decided to only test the long pulse length transformer to approximately 300 kv, and at that time tests would be initiated on the short pulse length transformer. The short pulse length unit would then be tested to full design capability and, based on these tests, a decision would be made regarding additional tests to be performed on the long pulse length unit. The preliminary tests on the long pulse length unit were performed and the transformer passed these tests satisfactorily. Tests were then initiated on the short pulse length unit, and during the course of the tests a transformer failure again occurred. In order to further reduce the possibility of a high voltage failure in the dielectric of the long pulse length unit, the primary windings were wrapped with layers of solid dielectric before continuing the tests. This transformer was then tested to 300 kv and 100 microseconds pulse length and subjected to a heat run at this level. The transformer passed these tests satisfactorily.

The short pulse length transformer was rebuilt with solid insulation added to its primary windings also. The pulse characteristics of the long pulse length transformer had been reviewed prior to this time and were

considered satisfactory for the initial klystron tests. Consequently, a decision was made to store the short pulse length unit upon completion and install and test it at the site at some future time. Effort was intensified on this transformer, and it was completed just prior to the delivery of the transformer tank to the site. At the time the transformer tank was prepared for delivery by removing the oil from the tank, the short pulse length transformer was installed without delaying the tank delivery schedule. Electrical tests, of course, were not performed on this transformer. These tests will be conducted at the site at some time in the future should it become necessary to utilize this unit for klystron tests.

All of the interim modulator equipment was delivered to the site with the pulse transformer tank. This equipment was moved into final position and the interconnecting wiring completed. The final checkout and test phases were initiated at the conclusion of the installation phase. At the end of the quarter it remained to operate this modulator in conjunction with the pulse coupling capacitor and associated equipment in the modulator tank. These components were complete and installed at the end of the quarter and these tests will be performed early in the next period. Operation of the modulator into the klystron/magnet structure will take place at the time the magnet is installed in the klystron tank.

XIII. KLYSTRON TANK

During this quarter the lead shielding was added to this tank and the covers delivered to the site from storage. The mod-anode bias supply and associated resistors and bushings were installed. The tank was cleaned and the covers placed in position. The oil-to-air bushing used to connect the interim modulator to the components inside the tank was installed and connected to the appropriate circuitry. Oil will be processed into the tank early in the next period, and both high voltage and modulator tests will be conducted. At the conclusion of these tests the klystron section of this tank will then be available to receive a magnet and a tube for test.

XIV. SYSTEM LAYOUT

The system layout is complete with the exception of placing the crowbar in its final location and installing the required interconnecting wiring for the crowbar. All piping, conduit, gutter and wire were installed during the quarter to interconnect the control console, interim modulator, klystron tank, cooling system and high voltage power supply. The crowbar will be installed and interconnected during the next quarter.

XV. PULSE COUPLING CAPACITOR

This capacitor was delivered to the site early in the quarter and was installed in position after the interim modulator pulse transformer tank was delivered to the site. This capacitor will be tested under both high voltage and

pulse conditions early in the next quarter during the klystron/modulator tank test phase.

XVI. PULSE VIEWING RESISTOR

This resistor has continued in use for both high voltage and pulse measurements during the quarter. During the course of the high voltage power supply tests, a fault occurred in this viewing resistor. A visual inspection indicated that no apparent physical damage had occurred. Therefore, it is assumed that a vacuum capacitor used as a part of the compensating network in this resistor arced during the high voltage tests. This resistor will again be tested utilizing the switch tube test supply in order to locate the faulty component and the required replacement will be obtained. The switch tube test supply is now being utilized for crowbar evaluations. Therefore, the tests to be performed on this viewing resistor will take place at the conclusion of the crowbar tests at RADIATION at Stanford.

XVII. SWITCH TUBE TEST SUPPLY

This power supply has continued to be utilized during this quarter to perform high voltage measurements for the high voltage breakdown study program and to perform crowbar tests. This power supply will continue to be utilized for crowbar tests until the crowbar is disassembled for shipment to the site. At that time the high voltage measurements will be resumed.

XVIII. CONCLUSIONS

During this quarter the beam supply d-c tests were completed including a heat run at full output power. These tests were conducted with the power supply operating into a d-c dummy load which was cooled using the main cooling system. The interim modulator pulse transformers were rebuilt and one transformer was tested both at RADIATION at Stanford and at the site.

The modulator was delivered to the site and installed along with the control console, coupling capacitor, mod-anode bias supply and associated resistors. The equipment interconnecting wiring and piping was completed with the exception of the wiring associated with the crowbar.

The crowbar fabrication was completed and preliminary tests were conducted at RADIATION at Stanford during the quarter. These tests were conducted in conjunction with the switch tube test supply. Consequently, the high voltage breakdown measurements program will not be completed until the crowbar is shipped to the site early in the next quarter.

XIX. PROGRAM FOR THE NEXT INTERVAL

During the next quarter the major effort will be directed toward completing equipment tests. The beam supply and capacitor banks will be subjected to short circuit tests in conjunction with the crowbar tests at the site. The interim modulator will be operated in conjunction with the bias supply, resistors and bushings located in the modulator/klystron tank. These components as well as the high voltage transmission line will be operated at full d-c voltage by means

of the beam supply. The beam supply control panels previously operated remotely during the beam supply tests will be returned to the control console and the final checkout from this location will be completed.

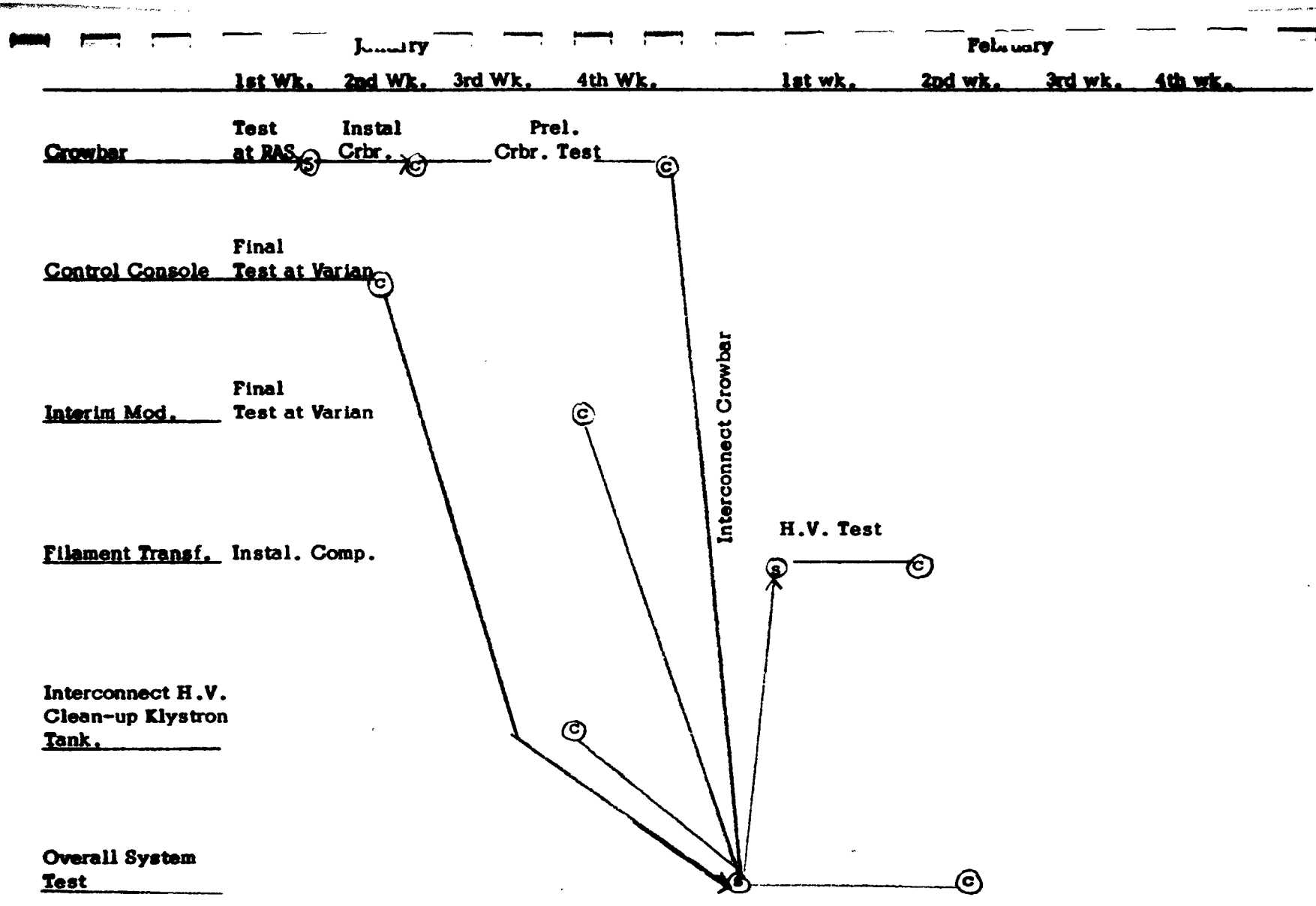
The remaining fabrication effort is basically associated with the installation and interconnection of the crowbar. This installation will be completed early in the quarter and the final crowbar tests initiated. At the conclusion of these tests the system will be available for klystron installation and tests.

Engineering, Production Engineering and Drafting effort will be expended during the quarter to complete the instruction books and finalize schematics, wiring diagrams, wiring tables, etc., as necessary to reflect changes made during the equipment test phases.

XX. TECHNICAL PERSONNEL ASSOCIATED WITH THIS PROJECT

R. L. Blessing, Project Manager; support technical personnel include: J. Sturdevant, L. H. Groh, H. Jessup, A. Poire, T. Innes and G. Reeser.

Engineering facilities were managed by V. L. Smith, Production Engineering and Drafting facilities by W. Bougher, and Production facilities were managed by E. Anderson.



PROJECTED SCHEDULE FOR POWER SUPPLY MODULATOR SYSTEM G-108.

Drawing #D108G024
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